

1 565 069

- (21) Application No. 37707/76 (22) Filed 10 Sep. 1976 (19)  
 (31) Convention Application No. 7510202 (32) Filed 12 Sep. 1975 in  
 (33) Sweden (SE)  
 (44) Complete Specification Published 16 Apr. 1980  
 (51) INT. CL.<sup>3</sup> F41H 5/20  
 (52) Index at Acceptance  
 F3C HA



(72) Inventors: SVEN ERIK BERGE  
 K. STEN R. HULTGREN

#### (54) IMPROVEMENTS IN AND RELATING TO TANK TURRETS

(71) We, AKTIENBOLAGET BOFORS, a joint-stock company organized according to the laws of Sweden, of S-690 20 Bofors, Sweden, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a tank having a turret which is rotatable relative to the tank chassis, the tank also rotatably supporting a large-calibre firearm.

There is a requirement for a tank in which notwithstanding a high position given to the firearm, the tank hull in other respects has a low profile, which makes it difficult to hit by enemy fire. At the same time, there is a requirement that the disposition of the space for the crew and equipment be made in a simple and uncomplicated way with optimal utilization of the spaces in the tank allotted to this purpose.

According to the invention there is provided a tank having a turret which is rotatable relative to the tank chassis and which supports a large-calibre firearm the tank having a crew position arranged under the turret and rotatable therewith and part of the turret extending down into the tank chassis to surround the head or head and shoulders of a person sitting in the crew position, wherein the wall of that part of said turret extending down into the tank is box-shaped in cross-section.

The tank is preferably given small external dimensions, particularly vertically, so that a so-called miniturret is formed. The turret, on its upper parts, can be provided with a carrier device for the elevation support of the firearm, and the turret moreover through a specific design can be arranged to withstand great mass and force influences obtained from the firearm. Embodiments proposed at present of a

device which has the characteristics significant for the invention will be described in the following, with reference to the accompanying drawings, in which

*Figure 1a* in a vertical view shows a tank utilizing the invention,

*Figure 1b* in a vertical view and in cross-section shows in an embodiment parts of the tank according to *Figure 1*,

*Figure 2* in a vertical view and partly in cross-section shows parts of the tank according to *Figure 1* in an enlarged condition,

*Figure 3* in a horizontal view shows certain parts comprised in *Figure 2*,

*Figure 4* in a wide-angle perspective shows the parts of the tank to which the invention relates.

In *Figures 1a* and *1b* the hull of a tank is designated 1, and a large-calibre firearm carried by the tank has been designated 2. The tank is provided with a miniturret with small external dimensions, particularly vertically. The turret 3 has upper parts projecting a limited extent above the other parts of the top of the tank, so that the turret in effect forms part of the top of the tank. The turret also has parts extending down into the tank chassis which rotatably support the turret in the tank. These parts extend downwards only to a limited extent so that, a person entering the turret has his head close to the ceiling of the turret and his neck and shoulders on a level with the downwardly extending parts of the turret as illustrated in *Figure 2*. The turret is moreover supported in relation to a frame 4 in the tank chassis via a ball bearing 5. On its upper part, the turret has a carrier with two side parts 6, in which the elevating trunnions 7 of the firearm are supported.

Under the turret, a crew position is located inside the space in the tank. The crew position has the form of a unit comprising a seat 8 for the person in question and a foot plate 9 in connection with the seat. The

unit also comprises a fastening member 10 in which the seat and foot plate are fastened and by means of which the seat and foot plate are connected to the turret 3. The fastening member is fixed to the turret at the parts of this which extend downwards, preferably to an end edge directed downwards formed at the parts, by means of welding, fastening with bolts etc. A sight 11 and an aiming device 12 are also connected to the turret which thus, like the seat and the foot plate, follow the traversing movements of the turret. At its upper parts, the turret is made with side viewing apertures 13 aligned with openings in the side parts 6 of the carrier.

Figure 2 also shows a slip-ring gear 15, located in the crew space in which, however, the seat is not supported. The reference designations 16 and 17 in Figure 1 indicate the motor and the rod for the elevating function of the firearm. Said motor and rod with the relevant gear mechanism are located behind the fastening member and follow the traversing movements of the firearm.

The tank is provided with a loading pendulum 18 arranged outside (on top of) the tank which can be actuated between a fetching position at a magazine 19 and a ramming position at the rear parts of the firearm. For the swinging up of this pendulum, the turret is made with a turning-up mechanism comprising a catch 20 fastened at one end of a straight gear rack 21 which can be actuated by means of a driving shaft on a driving motor located inside the tank. The gear rack is supported in a special recess in the turret, which also has a projection 22, which is elongate and rectangular, and is intended to protect the mechanism from foreign objects. The loading pendulum which is arranged not only so that it can be turned up, but can also be swung in a lateral plane so that it can assume various traverse positions independent of the tank chassis and the firearm, is made with a block 23, which can coast with the catch 20 in a lateral position of the loading pendulum which coincides with the lateral position of the firearm.

In the fetching position, which also constitutes the rest position of the pendulum when this is not being utilized, the pendulum is arranged in a trough 24 made in the tank chassis which is provided with hatch covers 25 which can be opened and closed. The loading pendulum is made with a part 18 for supporting the rounds, and with an arm 27 fastened in the part supporting the rounds which has one of its ends rotatably supported on a supporting shaft 28 which extends at right angles to the plane in Figure 1 and which in its other end is provided with a fork-shaped section, the prongs of which

extend on either side of the part 18 which supports the rounds, to which it is fastened at the middle parts of this. The support is made with springs arranged so that when the pendulum swings up, it will fix the position of the part supporting the round so that this will be essentially parallel to the longitudinal axis of the firearm. The part which supports the round consists of an armour tube which is made with a longitudinal and through slot at its upper end to provide for coaction with a rammer at the firearm. The armour tube is open at its ends, and on the front side it is provided with an extended bottom section. The loading pendulum can be turned up from the trough position shown in Figure 1 (fetching position) by means of a hydraulic cylinder which can coast with the arm 27. It is possible for the loading pendulum to swing in the traversing plane by means of a ring 30 which is rotatable in relation to both the turret 3 and the tank chassis around the traversing axis 31 of the firearm. The loading pendulum is supported on said ring with a trunnion support which is known in itself, and the block 23 is rigidly fastened in the arm 27. The loading pendulum is raised with the lifting cylinder from the shaft position to a position where it can coast with a fixed, circular slide track 32, by means of which the loading pendulum coasts via a roller 33 or the like on the arm 27. In order to lower the pendulum down into the trough during which lowering the arm 27 must be able to cross the slide track 32, the slide track is made with a lowerable part 32a, located where the arm 27 extends to the shaft position. The actuation of the lifting cylinder 29 of the arm 27 will thus take place via the lowerable part 32a of the slide track and the roller 33. The loading pendulum will work in a space between the top of the tank and the bottom of the firearm.

The magazine is of the external type, which can be turned up by means of a hydraulic cylinder 19a in order to prevent damage in case the tank should run into a ditch etc. In the horizontal direction, the magazine is rigidly fastened in relation to the tank chassis. The magazine is moreover fastened in such a way that its front edge is located somewhat to the rear of the rear end of the firearm, so that the loading pendulum will be adjustable with one of its ends to the magazine. The magazine has one or two feed-out positions. In the case where there is one feed-out position, the shaft position of the pendulum is distinct, while in the case of there being two feed-out positions on the magazine, the pendulum can be set at an angle in the shaft for coaction with the feed-out position in question. The magazine is made with a rammer which is known in itself, which feeds out the round nose first

70

75

80

85

90

95

100

105

110

115

120

125

130

from the magazine to the loading pendulum.

The recoil jacket of the firearm is provided with hatch covers 35, which can be turned up, on its under side. Said hatch covers coact with hatch covers 36 connected to the breech ring of the firearm, the covers 35 and 36 then being located on different levels, so that when the firearm recoils in the recoil jacket they can slide over each other. Said covers can be turned up by means of the loading pendulum at the ramming. At its rear end, the recoil jacket is provided with a hatch cover 37 for empty cartridge cases, which cover 37 can be turned up from inside by means of the cartridge cases and is closed by its own weight. At the ejection of the empty cartridge cases the covers 35 and 36 form a trough for the empty cartridge cases. Said hatch covers 35-37 form an efficient seal against foreign objects. At the recoil jacket the firearm is moreover provided with a two-stage rammer, which is known in itself, and which operates with smooth ramming. Ramming in two stages is necessary as the firearm must permit a certain longitudinal displacement for the part of the loading pendulum which carries the round, due to the fact that the elevation centres of the firearm and the loading pendulum are different.

The turret is also made with mechanical catches 38a and 38b which are intended to function when the loading pendulum, after having fetched a round has sought the angle of traverse of the firearm. In the present case, the catches have the form of studs in the tank chassis (38a) and the turret (38b) which can coact with holes in the ring 30. Said catches can be released when the loading pendulum, after it has transferred the round to the firearm, returns to fetch a new round from the magazine. Said catches are connected to electromagnets or hydraulic valves, by means of which the catches can be released.

Figures 2 and 3 are intended to show parts to which the invention relates in more detail. The frame 4 has a box-shaped cross-section. The ring 30 is provided with an external gear arc via which the ring can be actuated by means of a motor, the shaft of which is designated 39.

The shaft 39, with its gear wheel, is arranged at openings in the frame 4. The turret 1 is made with a roof of heavy armour plate, and in order to achieve a rigid design, the parts extending downwards are made box-shaped with inner and outer walls 1a and 1b and with a bottom part 1c. At the upper parts the turret is provided with a flange with a triangular cross-section with a horizontal part 1d, an oblique part 1e and a vertical part 1f. The flange extends with an overlapping part 1g over the ring 30 which is

supported on the outside of the vertical part 1f by means of ball bearings 40 and 41. At its parts which extend downwards, the turret is provided with an outer gear arc via which the turret is rotatable with a driving motor 42 with driving shaft and gear wheel 43 and 44, respectively.

The member 10 consists of a beam which in its cross-section is box and arc shaped. At its lower end, the member is fastened in the seat and foot plate, and at its upper end to the part 1c in the turret. The member extends in relation to the part 1c  $1/4 - 1/3$  of the length of this. The motor 16 and the shaft 17 for the elevating movements of the firearm are fastened in the member via a distribution gear 45 (Figure 1) belonging to it.

Briefly, the equipment described in the foregoing functions in the following way. The gun layer is assumed to be tracking a target, and the firearm is to be loaded with a round from the magazine. It is also assumed that in the magazine the round is in the feed-out position. The rammer of the magazine moves out the round with the point first into the loading pendulum. When the round has been inserted in the pendulum, this is turned up out of the trough by means of the lifting cylinder so that the pendulum can swing up into the traversing plane, supported on the slide tack 32 via its roller 33 on the arm 27. The swinging in the traversing plane then continues until the loading pendulum has a position in traverse which coincides with the traverse position of the firearm, and the catches 38 are then activated. The loading pendulum is then turned up to the ramming position by means of the catch 23. When the two-stage rammer has moved the round out of the loading pendulum at the firearm, the loading pendulum can be returned in the reverse order to the magazine position to fetch a new round, etc. In conjunction with the ramming in accordance with the above, the catches 38 are released. The guidance of the loading pendulum is then handled so that regardless of the traversing position of the firearm, it will always take the shortest way from the magazine (the firearm) to the firearm (the magazine). This guidance can be carried out by means of microswitches, stops, etc. not shown in detail.

The driving motors for the turret, loading pendulum, rammers etc. can consist of hydraulic or electric motors, and in the electric case the driving can take place partly or entirely by means of the batteries of the tank, so that the driving will be independent of whether or not the tank is running.

Through the construction shown, it is thus possible to obtain an appropriate suspension of the firearm and possibilities of traversing

the firearm, at the same time as the profile of the tank under the firearm can be kept low, and the space inside the tank can be used in an optimal way. The power consumption at the traversing of the firearm will also be reasonable.

#### WHAT WE CLAIM IS:-

1. A tank having a turret which is rotatable relative to the tank chassis and which supports a large-calibre firearm the tank having a crew position arranged under the turret and rotatable therewith and part of the turret extending down into the tank chassis to surround the head or head and shoulders of a person sitting in the crew position, wherein the wall of that part of said turret extending down into the tank is box-shaped in cross-section.

2. A tank as claimed in Claim 1, in which the turret has a roof of armour plate.

3. A tank as claimed in Claim 1 or Claim 2, wherein that part of the turret which extends down into the tank is supported in a frame formed from hollow members having a box-shaped cross-section.

4. A tank as claimed in Claims 1, 2 or 3, wherein the crew position comprises a seat and a foot plate with a fastening member which is connected to the seat and foot plate, and is fixed to the underside of the turret.

5. A tank as claimed in Claim 4, wherein the fastening member consists of a beam with an arc-shaped cross-section, to one end of which the rear side of the seat and the foot plate are connected, the other end of the fastening member being fixed to the underside of the turret.

6. A tank as claimed in any one of the foregoing claims, wherein the crew position is provided with an aiming device which is rotatable with the turret.

7. A tank as claimed in Claim 6, where the aiming device is secured to the turret.

8. A tank as claimed in any one of the preceding claims, wherein a ring is supported on the turret via ball bearings or the like rotatable support and is rotatable in relation to both the turret and the tank chassis, and supports a loading pendulum for the firearm.

9. A tank as claimed in Claim 8, wherein the turret has on its upper parts a projection for protecting an operating mechanism for the loading pendulum.

10. A tank as claimed in Claim 8 or Claim 9, wherein the turret has a flange extending over the ring, to shield the ring from foreign objects.

11. A tank as claimed in any one of the preceding claims wherein the upper part of the turret is provided with viewing apertures.

12. A tank as claimed in Claim 11, wherein the upper part of the turret has

carriers for trunnions for elevating the firearm and apertures are provided in said carriers which align with the viewing apertures in said turret.

13. A tank substantially as described herein with reference to the accompanying drawings.

TREGEAR, THIEMANN & BLEACH,

Chartered Patent Agents,

Enterprise House,

Isambard Brunel Road,

Portsmouth PO1 2AN.

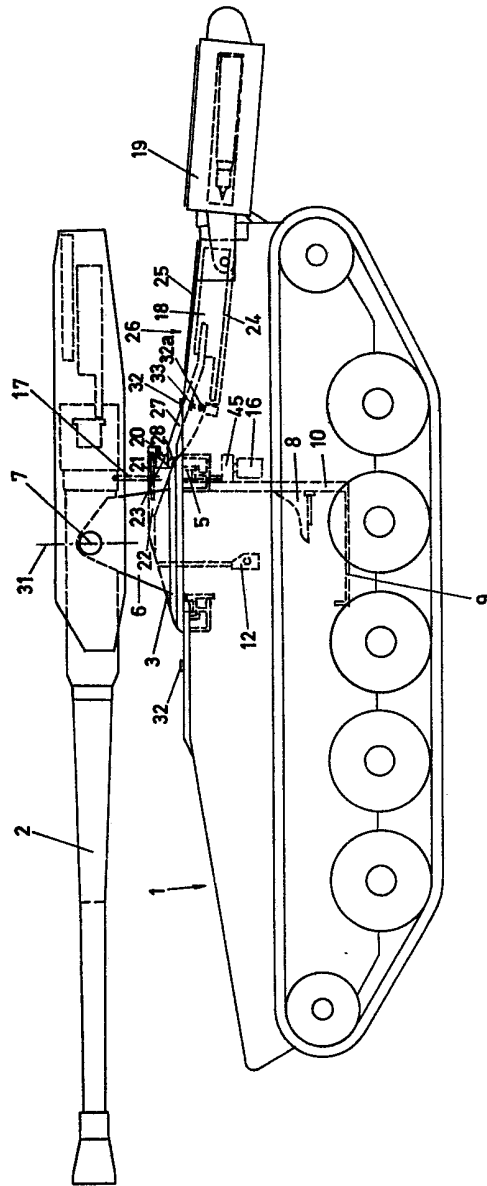
and

49/51, Bedford Row,

London WC1V 6RU.

Agents for the Applicants.

Printed for Her Majesty's Stationery Office,  
by Croydon Printing Company Limited, Croydon, Surrey, 1980.  
Published by The Patent Office, 25 Southampton Buildings,  
London, WC2A 1AY, from which copies may be obtained.



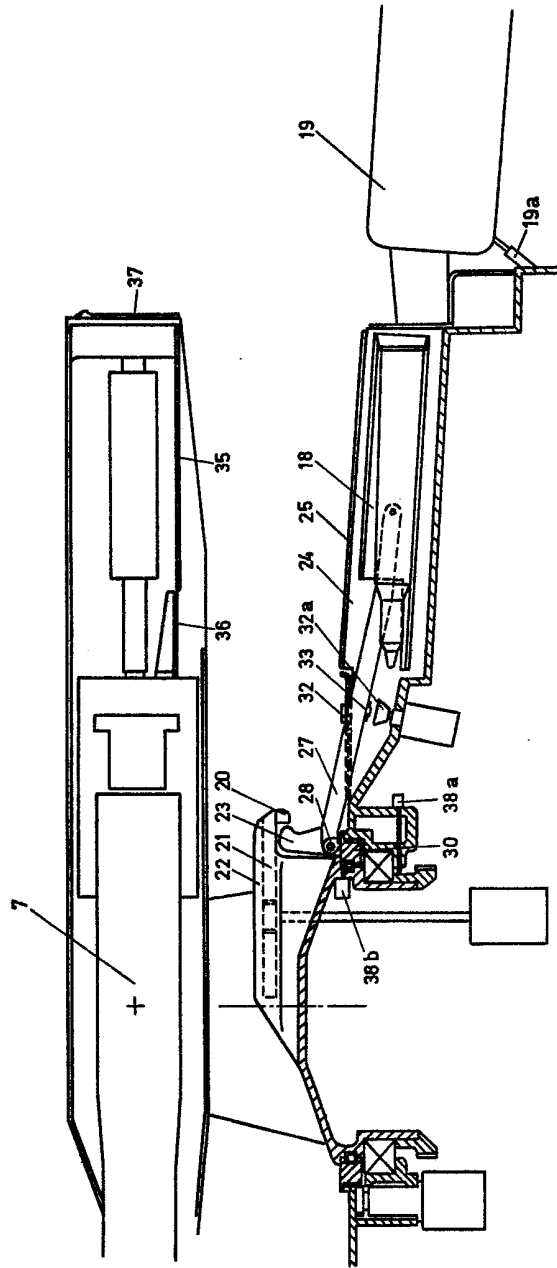


Fig. 1b

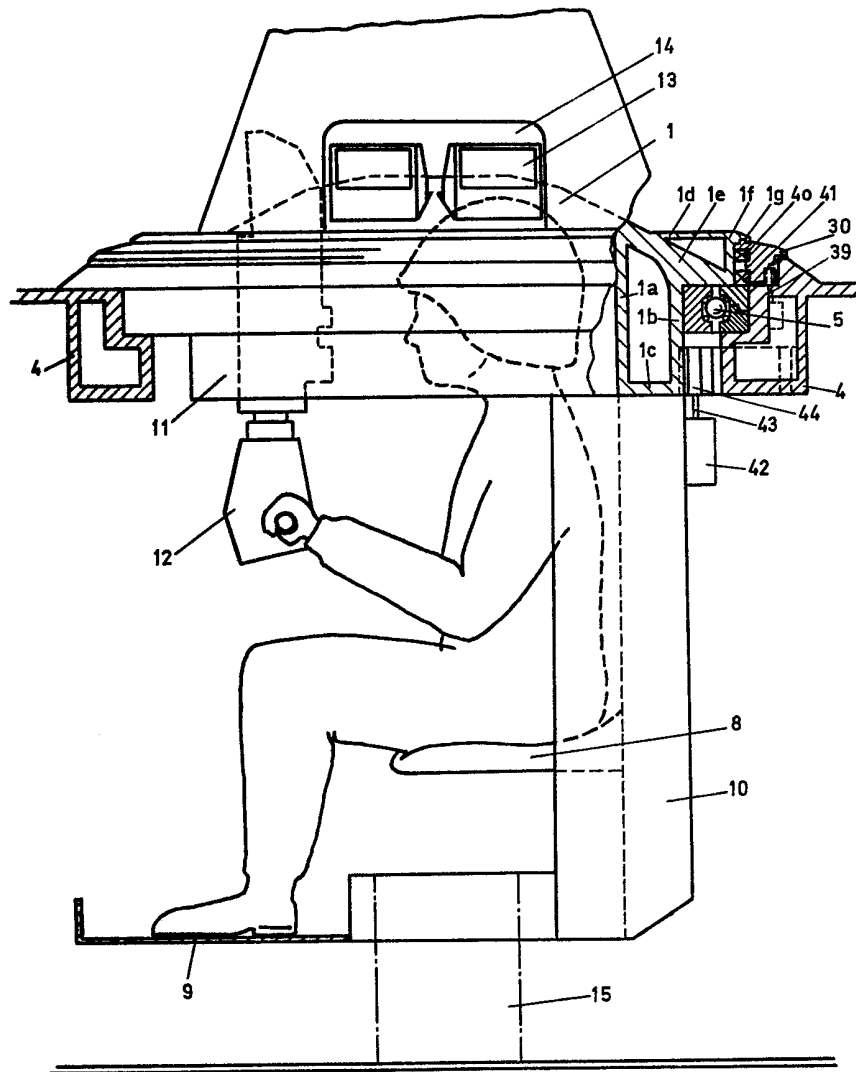


Fig. 2

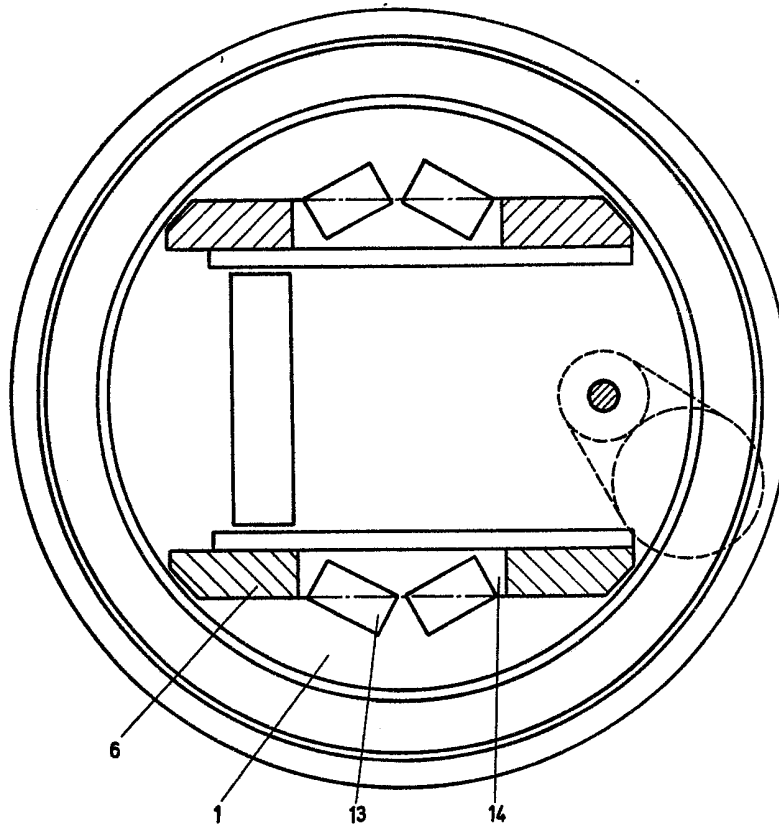


Fig. 3



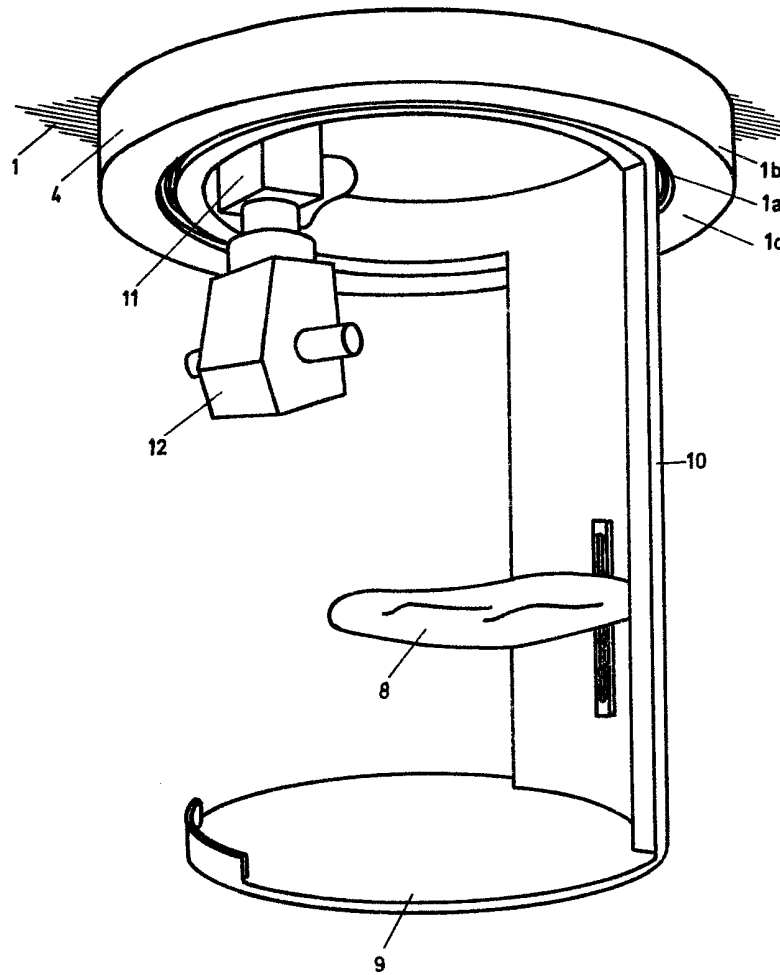


Fig. 4